THE

Malayan Agricultural Journal.

Vol. XIV.] DECEMBER, 1926. [No. 12

THE NIPAH PALM, FURTHER INVESTIGATIONS ON TAPPING & PRESERVATION OF THE JUICE.

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Three reports on investigations on the tapping of nipah palms have previously been published in this journal Vol. XI, No. 3, March, 1923, Vol. XII, Nos. 6—7 (June—July) 1924 and Vol. XIII, No. 3, March, 1925.

The following report contains further information on the results of tapping experiments during the period February 1924—September 1925, together with the results of experiments on methods of preserving the juice (nera) in order to avoid alcoholic fermentation, except under controlled conditions.

Tapping Experiments.

The figures of yields from the tapping experiments are given in Table I.

TABLE I.

Month.	Volume of juice per month (gallons).	Mean number of spathes during month.	Mean volume per spathe per month (gallons).	Max. yield during any 24 hours (gallons).	Min. yield during 24 hours (gallons).
1924					
February -	78.3	19.5	4.02	0.31	0.002
March -	82.5	26.4	3.13	0.30	0.004
April -	86.9	28.6	3.03	0.24	0.005
May -	49.2	16.7	2.95	0.24	0.005
June -	47.7	14.5	3.36	0.21	0.005
July -	59.1	18.9	3.16	0.24	0.005
August -	56.0	30.8	1.83	0.25	0.004
September	60.0	29.3	2.04	0.28	0.005
October -	68.5	32.0	2.12	0.30	nil
November	55.7	25.6	2.18	0.22	0.005
December	61.3	30.1	2.04	0.29	0.005

TABLE I.—(Contd.)

Month.	Volume of juice per month (gallons.)	Mean number of spathes during month.	Mean volume per spathe per month (gallons).	Max. yield during any 24 hours (gallons.)	Min. yield during 24 hours (gallons).
1925					
January -	68.6	25.9	2.65	0.26	0.005
February -	69.0	32.2	2.45	0.28	0.005
March -	61.8	30.6	2.02	0.18	0.005
April -	59.5	29.4	2.02	0.32	0.005
May -	54.8	24.5	2.41	0.26	0.004
June -	42.0	21.0	2.00	0.18	0.005
July -	38.0	19.0	2.00	0.18	0.004
August -	38.1	22.1	1.72	0.19	0.005
September	38.5	23.7	1.71	0.22	0.005

Observations on Yields.

The average yields during 1925 are lower than those obtained during 1924, while the yields during May & June 1924 and August 1924 to January 1925, are lower than those of the corresponding months during 1923.

It is considered that these decreases however are not due to the continued tapping of the palms. It is known that a considerable amount of juice was lost owing to depredations by deer and musangs during a phenomenally dry season in 1925. The dry weather also undoubtedly caused a decrease in yield, but this was compensated to some extent by the increased sugar content of the juice (cp. M.A.J. Vol. XII Nos. 6—7 1924, p. 158 Table III). The palms are growing on land which is above the sea drain so that it was impossible to keep the catch drains round the palms filled with water.

Fruiting of Palms and Effect of Tapping.

The condition of the various palms in respect of the number of fruiting spathes is shown in Table II below.

TABLE II.

No. of estimated seedlings (or parent palms).	No. of stands grown or spread from original seedlings.	Fruit formed, forming, or being tapped from series of stands of Col. 2, or parent seeds of Col. 1.	No. of flowers not arrived at fruit stage from each series of stands.	Total fruit flowers.	Mean of Col. 5 per stand.	Mean of Col. 5 per original seed.
1	6	1	1	2	0.33	2.0
1	7	6	3	9	1.43	9.0
1	8	5	4	9	1.20	9.0
1	6	4	2	6	1.00	6.0
2	12	1	0	1	0.08	0.5
1	4	4	1	5	1.25	
2	9	6	0	6	0.66	3.0
1	7	4	1	5	.71	7.0
2	12	6	2	8	0.66	4.0
2	10	7	1	8	0.80	4.0
1	4	4	1	5	1.25	5.0
2	11	0	0	0	0.00	0.0
2	9	2	2	4	0.44	4.5
1	3	3	0	3	1.00	3.0
1	5	0	2	2	0.40	5.0
1	7	0	0	0	0.00	0.0
1	5	4	4	8	1.60	8.0
1	3	0	1	1	0.33	3.0
1	6	0	0	0	0.00	0.0
1	5	7	4	11	1.80	11.0
2	9	5	2	7	0.77	3.5
1	6	9	1	10	1.66	6.0
1	5	4	0	4	.80	4.0
1	5	3	2	5	1.00	5.0
1	5	0	0	0	0.00	0.0
1	3	6	1	7	2.33	7.0
1	7	5	1	6	0.86	6.0
1	7	6	1	7	1.00	7.0
1	3	5	1	6	2.00	6.0
1	7	7	1	8	1.14	7.0
1	5	9	1	10	2.00	10.0
Tot. 38	Mean 5.3	3.96	1.29		0.99	4.65

The estimated age of the palms included in the above table is 10—12 years (June 1925).

The figures in the table must be considered approximate only, e.g., in Column 1, if two seedlings are shown, this is on account of the fact that the growth of the "stand" was so great that it was impossible to state definitely whether the stand was derived from one or two seeds, or, if from one seed, which fruiting spathe belonged to the particular seedling.

The figures show an average of one spathe per stand or between four and five per original plant, so that with an average yield per spathe of only two gallons of juice per month, a yield of ¼ gallon per original palm per day is maintained.

As a basis for our estimates, it has never been considered that, with 300 planted palms per acre, more than half will yield at one time during a year of 300 tapping days.

Judging from the healthy appearance of the palms and the large and continuous number of fruiting spathes formed it does not appear that the palms under experiment have suffered by three years continuous tapping, although, when large scale production commences, it may be considered advisable to adopt a periodic system of tapping and resting.

Preservation of Juice.

Experiments on the preservation of the juice to inhibit preliminary natural fermentation in the field, have been confined almost entirely to the anti-fermentative properties of sulphuric acid, which, as has been shown previously, at certain concentrations inhibits or retards the action of the yeasts which effect the conversion of the sugars to alcohol.

Experiment 1.—The first experiments were carried out with normal sulphuric acid (4.9 per cent) using 1/25th of the volume of juice collected. The percentage of sugars present in the juice was determined at the time of collection and after the juice had been stored for 5 & 9 days, while the percentage of alcohol was determined after 5, 9 & 15 days.

The flasks containing the "preserved" juice were left open, so that any fermenting spores present in the atmosphere of the laboratory had free access to the liquid. The results are given in Table III below, the alcohol being calculated as a percentage of the theoretical amount obtainable from the sugars lost during storage. The sugar is expressed as per cent on the juice.

TABLE III.

Normal Acid.

Palm No.	Original sugar.	Sugar after 5 days.	Sugar after 9 days.	Alcohol after 5 days.	Alcohol after 9 days.	Alcohol after 15 days.
1	20.4	12.5	8.4	77.0	60.5	71.0
6	18.2	11.9	6.1	52.5	59.6	78.0
7	19.4	15.2	10.2	58.0	63.0	80.0
9	17.5	11.9	9.3	50.0	61.0	80.0

Observations on Table III.—The results show that, although sulphuric acid in the proportion used retards fermentation it does not inhibit it, while it also appears to have an adverse effect on the amount of alcohol formed during the early stages of natural fermentation. Fermentation to alcohol was complete by the end of fifteen days in the presence of 4 per cent of normal (4.9 per cent) sulphuric acid.

Experiment 2.—A more detailed investigation of the rate of decrease of the sugar was carried out using a decinormal solution of sulphuric acid (=1.25 per cent of acid.)

In a series of six experiments in which 12.5 & 25 ccs of decinormal acid were added to the juice to make a total volume of 250 ccs, the results given in Table IV and graph No. 1 were obtained:—

TABLE IV.

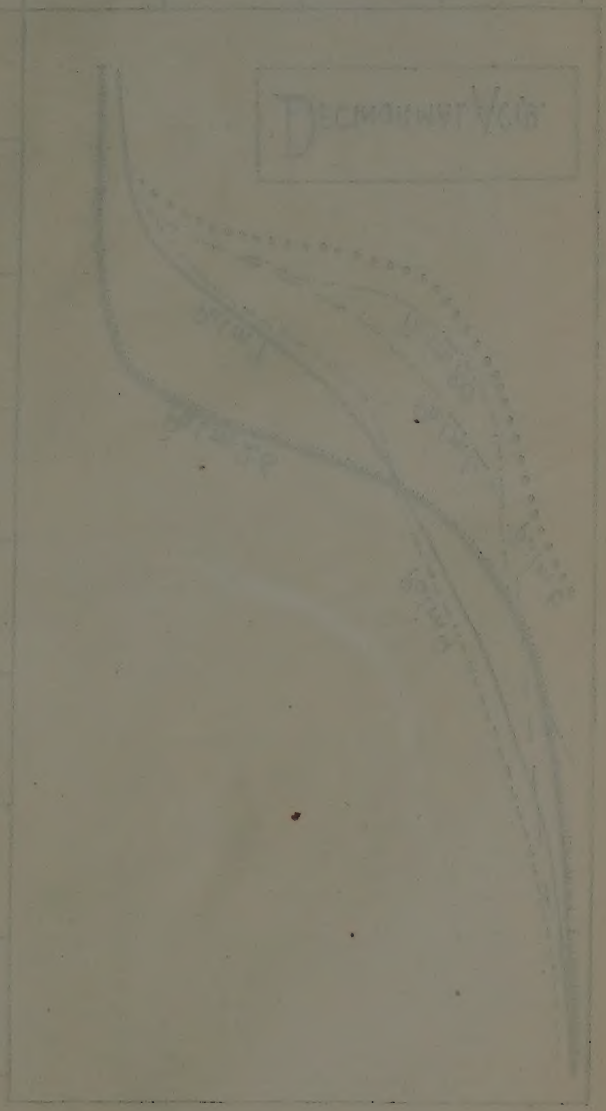
DECINORMAL ACID.

Date & Time.	Palm 7 percentage sugar.	Palm 9 percentage sugar.	Palm 26 percentage sugar.	Palm 1 percentage sugar.	Ralm 6 percentage sugar.	Palm 20 percentage sugar.
	12.5 ccs acid	12.5 ccs acid	12.5 ccs acid	25 ccs acid	25 ccs acid	25 ccs acid
25-8-24 6 p.m.	16.50	16.50	17.09	16.50	16.69	16.69
26-8-24 10 a.m.	16.29	16.09	17.09	16.29	16.50	16.69
27-8-24 10 am.	13.47	12.72	17.09	9.86	5.78	5.45
28-8-24 10 a.m.	7.70	6.67	7.75	5.00	2.86	2.41
28-8-24 8 p.m.	6.76	6.35	6.35	2.33	2.60	0.47
29-8-24 noon	4.67	4.90	3.30	2.11	1.17	0.47
30-8-24 1 p.m.	2.70	3.06	1.16	2.06	trace	trace
31-8-24 4 p.m.	0.94	1.53	0.45	1.19	...	...
1-9-24 3.30 p.m.	0.34	0.78	0.25	0.53	...	...
2-9-24 3.30 p.m.	0.25	0.78	0.16	0.41	...	...

Observations on Table IV.—It will be seen that in the last three columns, in which twice the amount of acid was

GRAPH 1.

7.30AM 1.9.24
7.30AM 31.8.24
7.30AM 30.8.24
7.30AM 29.8.24
7.30AM 28.8.24
7.30AM 27.8.24
7.30AM 26.8.24
7.30AM 25.8.24
TIME
Palm 9
Palm 6
Palm 2.6
Palm 1
Palm 7
Palm 80
DECINORMAL ACID.
20%
15%
10%
5%
0%
PERCENTAGE SUGAR



added, the amount of sugar decreased more rapidly than in the experiments in which only half the amount of acid was added (Column 1—3).

This is probably due to the higher concentration of acid causing inversion of the sugar, without being sufficiently concentrated to decrease the rate of fermentation.

Experiment 3.—In a further experiment 10 ccs of normal (4.9 per cent) sulphuric acid were added to 240 ccs of juice to make a total volume of 250 ccs. The results of this experiment are shown in Table V below and graph No. 2.

TABLE V.

Normal Acid.

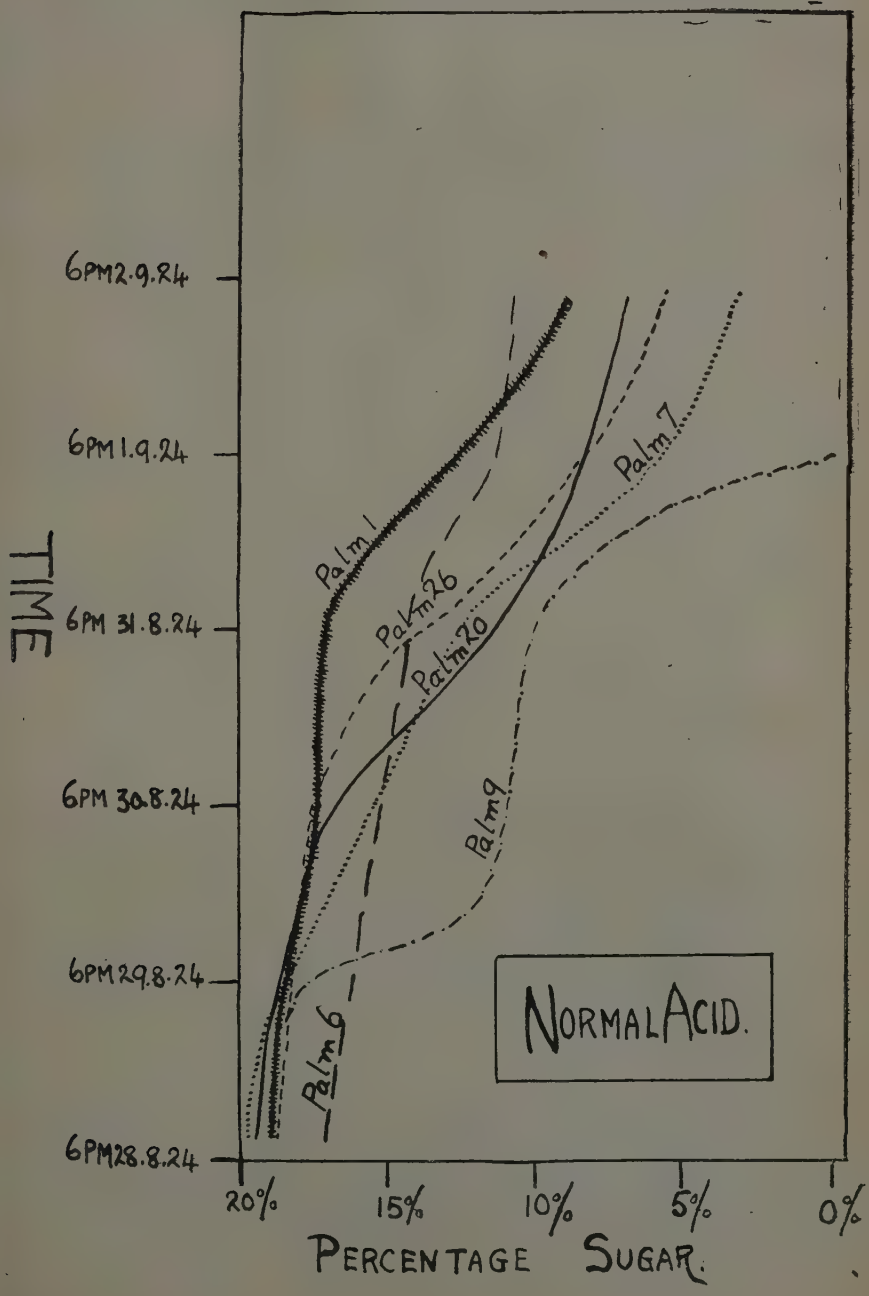
Date & Time.	Palm 20 percentage sugar.	Palm 26 percentage sugar.	Palm 1 percentage sugar.	Palm 7 percentage sugar.	Palm 9 percentage sugar.	Palm 6 percentage sugar.
28-8-24 8.30 p.m.	19.45	19.00	18.92	19.75	18.80	17.5
29-8-24 noon	19.18	18.94	18.92	19.18	18.42	1.16
30-8-24 2.15 p.m.	17.30	17.62	18.18	16.30	11.20	15.55
31-8-24 4.30 p.m.	11.65	17.30	14.57	12.73	10.27	14.64
1-9-24 4.0 p m.	8.60	12.4	8.75	6.93	trace	11.52
2-9-24 4.0 p.m.	6.95	8.9	5.70	3.37	...	10.77

Observations on Table V.—The results in Table V show that normal acid in the proportion added has a considerable retarding effect on rate of fermentation.

Experiment 4.—In a final series of experiments with sulphuric acid, solutions of varying concentration were added under similar conditions. The procedure adopted was as follows—Standard solutions of 4 normal (19.6 per cent) and decinormal (0.49 per cent) sulphuric acid were prepared and 4 ccs of decinormal acid were added to each 100 cc collecting flask.

Each flask was attached to a spathe at about 6 a.m. and collection was complete in all flasks by 11 a.m. The contents of the flasks (8) were mixed and 94 ccs of the mixed juice was returned to each flask, which were then filled to the 100

GRAPH 2.


6PM 2.9.24
6PM 1.9.24
6PM 31.8.24
6PM 30.8.24
6PM 29.8.24
6PM 28.8.24
TIME
Palm 1
Palm 26
Palm 20
Palm 9
Palm 6
Palm 7
NORMAL ACID.
20%
15%
10%
5%
0%
PERCENTAGE SUGAR.

the mark with different amounts of decinormal and 4 normal sulphuric acid to bring the final concentration of the acid in the juice to the figures shown in Table VI below.

TABLE VI

ccs N/10 Acid added to 94 ccs of juice.	ccs 4N Acid added to 94 ccs juice.	Final Concentration of acid in mixed juice.	Col. III expressed as per cent of acid in juice.
6.25	nil	N/80	0.61
5.76	0.38	N/32	1.52
5.08	1.07	N/16	3.06
4.55	1.70	3N/32	4.56
3.89	0.31	N/8	6.12
3.14	3.11	N/6	8.22
2,25	4.01	5N/24	10.20
1.25	4.90	N/4	12.24

The residual 48 ccs of the mixed juice was preserved by the addition of an excess of alcohol and the sugar determined on arrival at the laboratory.

Samples were taken periodically from each of the flasks and the sugar content was determined.

The results are shown in Table VII and in graphs Nos. 3 & 4.

Observations on Table VII.—Although there is a difference on the first day, at a mean age of 8 to 9 hours, of about 4 per cent in the sugar content of the juice preserved with the highest concentration of acid and that preserved with the most dilute acid, this difference has decreased considerably during the subsequent twelve hours and after this period, the sugar being completely inverted in all samples, fermentation proceeds fairly rapidly in the samples containing dilute acid, while in the samples containing stronger acid, the sugar content remains constant over a period of three days.

These figures apply only to the particular sample of juice, but can be taken as a guide generally, since the actual amount of sugar in a preserved juice at any given time will depend on factors, such as the time at which the juice is collected (e.g. morning or evening) temperature, rain before or during collection, which will affect the contamination of the juice with natural yeasts etc.

GRAPH 3.

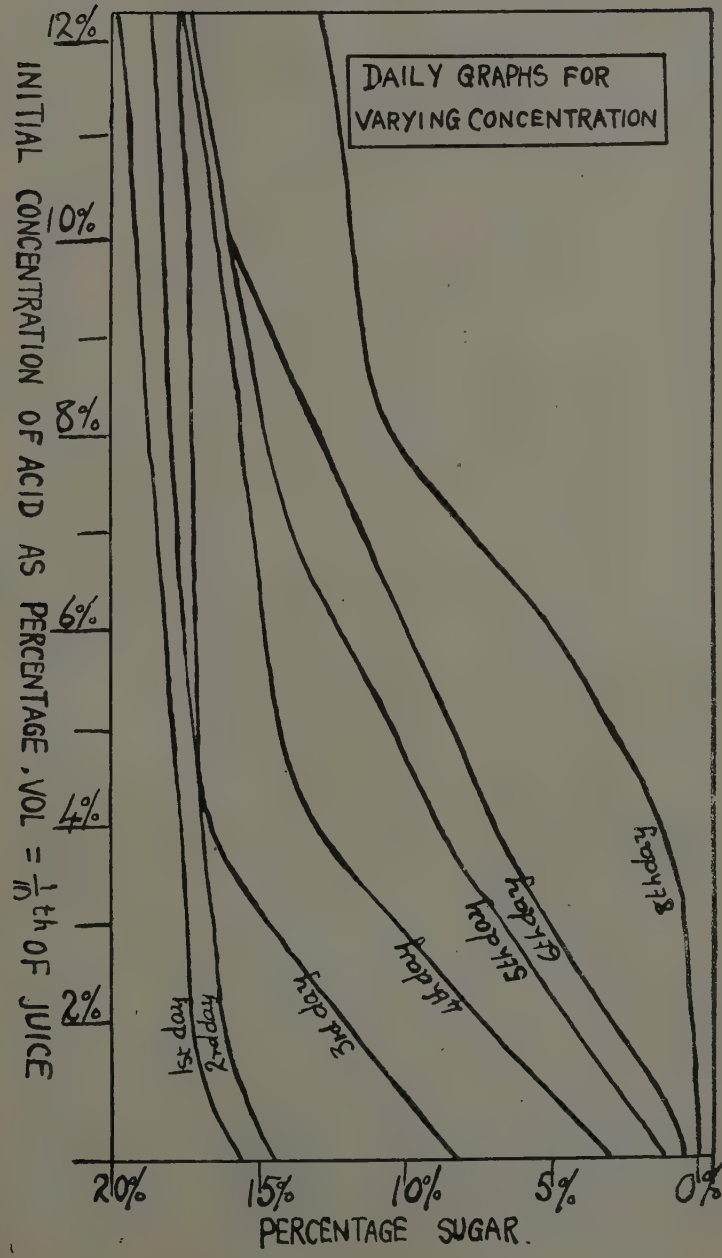
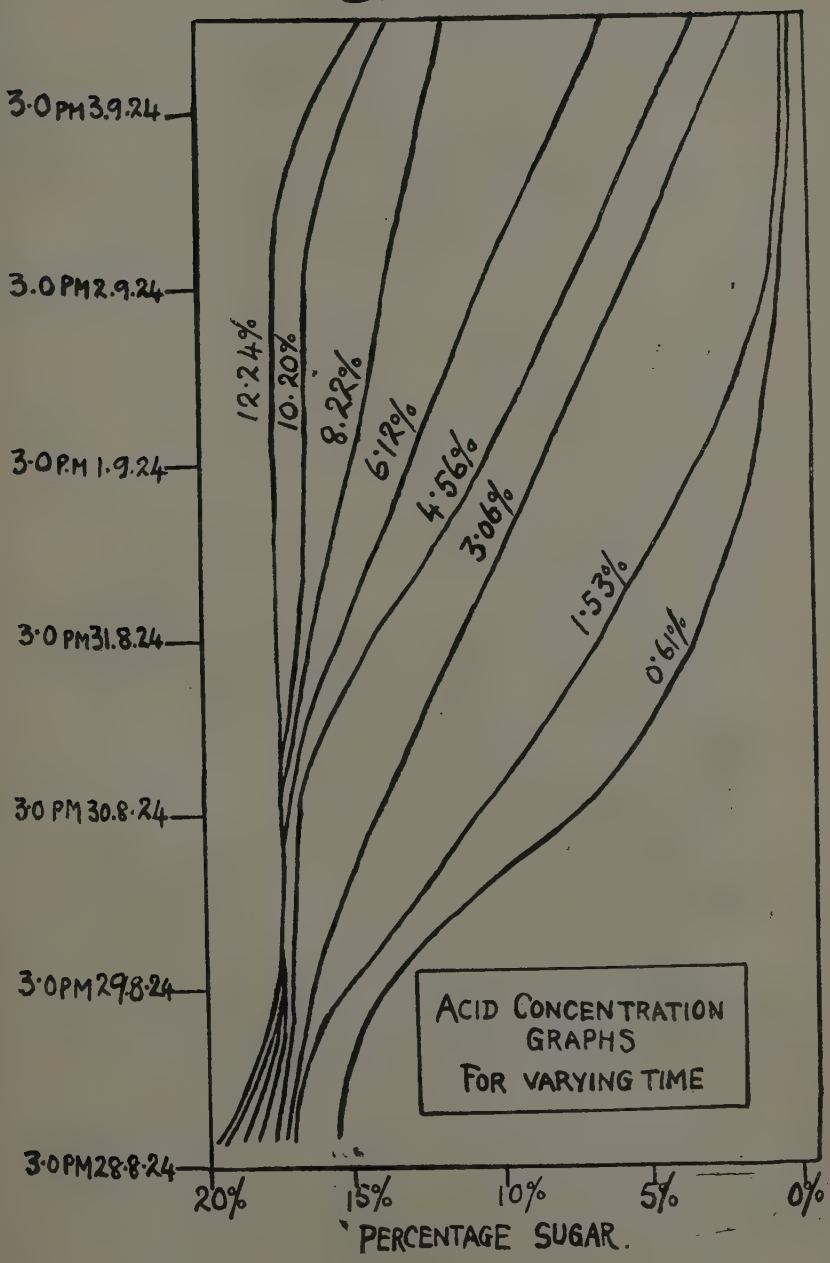

DAILY GRAPHS FOR VARYING CONCENTRATION
INITIAL CONCENTRATION OF ACID AS PERCENTAGE, VOL = 1/10th OF JUICE
12%
10%
8%
6%
4%
2%
20%
15%
10%
5%
0%
PERCENTAGE SUGAR.
1st day
2nd day
3rd day
4th day
5th day
6th day
7th day
8th day

TABLE VII

Original Sugar 19.75% Date and Time.	N/80 Ttl. Sugar.	N/80 Invt. Sugar.	N/32 Ttl. Sugar.	N/32 Invt. Sugar.	N/16 Ttl. Sugar.	N/16 Invt. Sugar.	3N/32 Ttl. Sugar.	3N/32 Invt. Sugar.	1N/8 Ttl. Sugar.	1N/8 Invt. Sugar.	N/6 Ttl. Sugar.	N/6 Invt. Sugar.	5N/24 Ttl. Sugar.	5N/24 Invt. Sugar.	N/4 Ttl. Sugar.	N/4 Invt. Sugar.
28–8–24.																
6.30 p,m. -	15.70	1.40	17.09	1.63	17.50	0.98	17.72	1.51	18.40	2.00	18.80	2.04	19.60	2.45	19.70	3.38
29–8–24.																
11.30 a.m. -	14.60	10.53	16.09	13.25	16.65	4.37	17.08	4.45	7.50	5.36	17.71	9.25	17.71		17.71	11.1
INVERSION COMPLETE.	TOTAL.		TOTAL.		TOTAL.		TOTAL.		TOTAL.		TOTAL.		TOTAL.		TOTAL.	
30–8–24.																
Noon -	7.96		11.25		14.45		17. 0		17.30		17.30		17.50		17.50	
31–8–24.																
5 p.m. -	3.07		6.66		10.80		14. 0		14.90		16.10		16.47		17,50	
1–9–24.																
4 p.m. -	1.40		2.85		7.78		9.45		12.75		14.75		16. 3		17.08	
2–9–24.																
3.30 p.m. -	0.68		1.06		5.68		7.62		10.60		13.63		16. 3		17.08	
4–9–24.																
1.30 p.m.	10.14		10.14		0.25		2.04		4.66		10.79		11.68		12.80	

GRAPH 4.


3·0 PM 3.9.24
3.0 PM 2.9.24
3·0 P.M 1.9.24
3·0 PM 31.8.24
3·0 PM 30.8.24
3·0 PM 29.8.24
3·0 PM 28.8.24
12·24%
10·20%
8.22%
6·12%
4·56%
3·06%
1·53%
0·61%
ACID CONCENTRATION GRAPHS FOR VARYING TIME
20%
15%
10%
5%
0%
PERCENTAGE SUGAR.

Cost of Preservation and Loss of Alcohol.

The cost of preservation of the juice with sulphuric acid, as compared with the value of the probable loss of alcohol is given in Table VIII below.

TABLE VIII.

Strength of preserving acid.	Value of Acid in cents. per gallon of juice collected.	Value in cents of probable loss of alcohol per gallon of juice.	Total in cents.
N/80	0.012	0.53	0.542
N/32	0 028	0.32	0.348
N/16	0.056	0.27	0.326
3N/32	0.092	0.22	0.312
1N/8	0. 12	0.19	0.310
N/6	0. 16	0.12	0.280
5N/24	0. 20	0.08	0.280
N/4	0. 24	0.03	0.270

Observations on Table VIII.—The price of commercial sulphuric acid (96 per cent) is taken as 4d. per lb. F.O.B. (including container) or with 40 per cent added for freight costs, say 20 cents per lb. in Malaya, while the loss of alcohol has been calculated from the figures in Table VII and is based on alcohol (95 per cent) at 1/- (one shilling) per gallon. Since the value of the alcohol lost decreases much more rapidly than the value of the sulphuric acid used increases it is preferable to use the more concentrated acid, provided glazed or other suitable collecting vessels are employed. No allowance has been made for the cost of lime required for the subsequent neutralization of the acid, since this is very small compared with the value of the acid and alcohol. The figures in Table VIII apply strictly only on the basis of the results shown in Table VII but can be taken as a general guide.

Fermentation on a large scale only will determine whether it will be essential or economical to retard or inhibit natural fermentation of the sugars to alcohol by the addition of sulphuric acid, owing to other factors involved in addition to cost of the sulphuric acid and its subsequent neutralisation with lime.

POLLINATION EXPERIMENTS WITH OIL PALMS.

J. N. Milsum and E. A. Curtler.

Considerable attention is being given to the cultivation of the oil palm, *Elaeis guineensis Jacq.*, at the Experimental Plantation, Serdang, and at the present time there are about 112 acres of this palm under various experiments.

The palms under reference in this paper consist of an avenue situated approximately in the centre of the plantation. The avenue runs East to West and consists of 86 palms planted in May, 1922, in rows 36 feet apart at a distance of 30 feet apart in the rows. This avenue is situated about half a mile from the nearest palm in the main oil palm area.

As the two rows forming the avenue are open on the outside these palms have a considerable advantage over those planted in blocks owing to their increased spacing.

The object of the experiment is to record the effect of artificial pollination, at a rate not exceeding one female inflorescence on each palm per month, in view of their immature age, as against palms under similar conditions that are not pollinated artificially. It is proposed to carry on these records over a period of years, but at present the work will serve as a guide to further experiments on the large number of palms now coming into bearing.

It should be clearly understood that so far this experiment has been carried out to test the effect of pollinating immature palms, a practice which is not generally recommended under ordinary conditions.

The palms that are being pollinated artificially are situated on the south side of the avenue while the control palms are on the north side. The palms are numbered 1 to 86, those being pollinated by hand having the odd numbers and the control palms the even numbers.

The seeds were obtained from ten-year old palms growing at the Experimental Plantation, Kuala Lumpur. These are of the "Deli type", i.e., var *dura*, which is that commonly planted in Sumatra and the Malay Peninsula. In this type the pericarp is about 58 per cent. of the weight of the fruit.

The seeds were sown in sand beds during March, 1921 and subsequently transferred to open nursery beds. In May, 1922 the most forward palms were lifted and planted in the avenue.

The soil may be described as a sandy loam with traces of laterite in places and is typical of the inland soils of Selangor, and similar to land that has been opened up recently for oil palm cultivation in inland areas of the Peninsula.

The annual rainfalls recorded at the Experimental Plantation, Serdang, during the period of this experiment to date are as follows:—

Year.	*Inches.*
1922	87.86
1923	81.94
1924	92.37
1925	101.94

A commencement was made artificially to pollinate the palms on the south side of the avenue on the 1st August, 1924. The yields obtained from the two sets of palms during the last five months of 1924 are recorded in Table 1, but these results are not affected by the artificial pollination. In Tables II and III are recorded the yields obtained from the artificially pollinated palms and control palms respectively during the year 1925.

The palms were 2¼ years old from planting out on the 1st August, 1924, and were rather large for their age.

Of the 86 palms under observation, the first male spadix appeared about the middle of May, 1923, and the first female inflorescence early in December of the same year. At the time of pollination, 1st August, 1924, 37 palms or 43 per cent of the total number were bearing female flowers.

The method of pollination of the oil palm already has been outlined in this journal (1). It is unnecessary, therefore, to repeat the details of this operation. As the palms are young and few in number, the work of pollinating the female flowers and patrolling the palms was carried out with great care.

As regards pruning, owing to the young state of the palms, only those leaves obstructing the development of the fruit were removed.

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(1) Malayan Agricultural Journal, Vol. XII, 1924, p. 145.

A maximum of one bunch per palm was pollinated during each month, though frequently additional bunches matured as the result of natural fertilization. It has already been mentioned in this Journal (2) that the pollination of every bunch is likely to result in a weakening of the palms with a subsequent reduction of yield. The results of Experiments conducted at the Experimental Plantation, Kuala Lumpur with mature palms confirmed this statement.

The pollen for use in the experiment was collected from the palms on the south side of the avenue. This being done to prevent undue interference with the palms left to be pollinated naturally.

It has already been stated that the palms in the avenue had the advantage of being planted in the open.

TABLE I.

Yields from Palms Producing Fruit in 1924.

Pollinated Palms (Preliminary Records).

Palm No.	No. of mature bunches.	Total weight of bunches lbs.	ozs.	Total weight of fruits. lbs.	ozs.	No. of fruits
7	2	7	8	2	4	81
11	2	9	4	4	0	375
23	1	2	—	—	9	16
27	3	10	4	1	15	60
31	1	4	—	2	1	82
37	1	4	8	1	4	66
43	1	1	8	—	6	47
65	2	8	4	1	13	149
67	3	14	—	5	—	239
69	3	13	12	4	5	145
71	4	22	—	12	4	353
77	2	5	4	1	12	167
Totals -	25	102	4	37	9	1780

(2) Malayan Agricultural Journal, Vol. X, 1922, p. 240.

Control Palms (Preliminary Records).

Palm No.	No. of mature bunches.	Total weight of bunches. lbs.	ozs.	Total weight of fruits. lbs.	ozs.	No. of fruits.
4	1	4	—	—	10	42
10	3	7	12	1	10	52
18	2	9	8	1	3	59
20	2	2	12	—	13	36
22	1	3	4	1	5	65
28	3	9	8	4	4	197
30	1	2	8	1	10	38
32	1	2	—	—	14	45
36	1	2	4	—	12	25
38	1	1	8	—	10	34
42	1	2	8	1	1	52
52	4	12	12	5	9	161
54	2	5	8	2	5	138
56	2	11	8	5	12	234
58	3	11	—	5	12	191
60	3	17	—	8	8	309
62	1	1	—	—	3	13
64	1	1	8	—	8	45
70	1	5	8	2	8	100
84	1	2	—	1	—	116
Totals -	35	115	4	46	13	1952

It will be noted from Table I that of the 43 palms receiving artificial pollination, 12 palms or 28 per cent. of the total produced mature bunches during the last five months of 1924. Of the control palms, unpollinated, 20 palms or 47 per cent. fruited. The period between flowering and harvesting the bunches of the oil palms in the avenue is six to seven months, consequently none of the mature bunches cut during 1924, had received artificial pollination. Thus 32 palms or 37 per cent. of the total fruited within two and a half years of planting. The yields during the preliminary period are almost negligible, but are included in this paper for the purpose of keeping a complete crop record of the palms under observation.

TABLE II.

Yields from Pollinated Palms, 1925.

Palm No.	No. of mature bunches.	Total weight of bunches. lbs.	ozs.	Total Weight of fruits lbs.	ozs.	No. of fruits.
1	14	154	8	101	14	5010
3	13	114	12	74	10	3807
5	14	239	12	161	5	6997
7	11	104	14	65	4	2597
9	15	184	14	122	1	6383
11	7	45	6	25	12	1988
13	11	109	8	69	11	3279
15	7	29	8	12	5	928
17	3	15	12	7	2	529
19	5	31	12	18	7	1063
21	9	67	00	44	00	1635
23	12	104	2	63	2	2873
25	9	53	14	30	11	2021
27	10	144	4	98	9	4865
29	—	—	—	—	—	—
31	5	53	6	33	—	1993
33	—	—	—	—	—	—
35	9	64	8	38	14	2001
37	11	158	5	97	10	4546
39	9	40	14	24	4	1625
41	5	22	2	15	4	895
43	10	105	14	74	7	3000
45	9	69	2	40	14	2303
47	7	59	2	40	12	1993
49	3	14	—	7	5	256
51	1	4	12	2	—	87
53	6	50	2	30	13	1911
55	8	33	10	18	11	1429
57	9	83	10	48	15	2543
59	3	13	4	5	8	361
61	7	62	4	39	—	2196
63	7	20	6	11	6	541
65	17	150	8	102	5	3571
67	13	152	8	103	5	3996
69	8	39	6	22	2	1380
71	13	148	6	93	4	3603
73	3	24	14	13	14	987
75	—	—	—	—	—	—
77	14	80	—	43	14	3593
79	14	110	2	54	15	3715
81	7	72	2	45	15	2283
83	3	14	2	6	—	333
85	8	69	2	42	4	2156
Totals -	349	3116	5	1951	6	97272

TABLE III.

Yields from Control Palms, 1925.

Palm No.	No. of mature bunches.	Total weight of bunches. lbs.	ozs.	Total weight of fruits. lbs.	ozs.	No. of fruits.
2	2	7	12	3	6	112
4	2	7	12	2	—	113
6	—	—	—	—	—	—
8	1	3	12	2	14	182
10	4	14	10	5	—	195
12	1	13	12	8	6	388
14	1	13	8	8	12	506
16	1	2	12	—	1	1
18	2	11	8	5	4	207
20	5	14	12	4	10	234
22	—	—	—	—	—	—
24	1	1	—	—	2	2
26	3	21	10	13	9	854
28	4	11	14	2	6	93
30	1	1	14	—	5	9
32	1	13	12	9	2	546
34	3	28	14	14	8	1,008
36	1	1	4	—	3	11
38	3	6	6	1	—	34
40	1	—	12	—	3	3
42	3	15	12	8	14	537
44	11	106	—	59	9	2,531
46	2	21	2	12	8	604
48	1	2	8	2	6	89
50	1	1	14	—	3	27
52	2	7	12	1	8	57
54	5	42	8	21	10	652
56	6	42	6	22	6	609
58	7	35	8	18	2	847
60	9	54	—	26	7	1246
62	2	7	4	1	10	79
64	7	14	14	3	15	395
66	7	79	14	43	15	235
68	1	1	4	—	8	23
70	4	36	6	20	4	794
72	8	26	8	12	—	496
74	5	27	12	10	3	472
76	6	23	14	7	—	379
78	—	—	—	—	—	—
80	3	7	2	1	1	75
82	—	—	—	—	—	—
84	4	23	8	16	5	828
86	6	20	12	7	10	688
Totals -	137	776	00	379	11	17158

TABLE IV.

Summary of Results Obtained in Tables II and III.

Particulars.	Artificially Pollinated Palms.	Control Palms.
Number of Palms -	43	43
Number of Productive Palms -	40	39
Number of Bunches Harvested -	349	137
Average Number of Bunches per Fruiting Palm -	8.72	3.51
Total Weight of Bunches -	3,116 lbs.	771 lbs.
Total Weight of Fruit -	1,951 lbs.	379 lbs.
Average Weight of Fruit per Yielding Palm -	48.77 lbs.	9.72 lbs.
Total Number of Fruits -	97,272	17,158
Number of Fruits per lb. -	50	45

Observations on Table IV.

In view of the fact that the two sets of palms were only 3½ years old from planting at the end of 1925, (i.e., the year during which the crop yields have been recorded) it is as yet too early to draw any definite conclusions regarding the advisability of artificial pollination of young palms. The results show however, that artificial pollination has a marked effect on the yield of such palms. The increase in favour of pollinated palms, in respect of total weight of fruit harvested during the year, amounts to over 400 per cent. or almost five times as great. The yield from the control palms might however have been greater had there been a larger number, with a consequent increase in the amount of pollen shed.

It is to be expected that artificial pollination would show most marked results during the early stages of the growth of the palms when the flowers are but a few feet from the ground and covered by an umbrella of foliage. This covering would naturally restrict the free movement of pollen by wind or insects.

MEASUREMENTS OF PALMS.

The following measurements of the palms on both sides of the avenue, taken at the end of the year 1925, are recorded:—.

TABLE V.

Pollinated Palms.

Palm No.	Height.	Spread.	Circumference at base.		Palm No.	Height.	Spread.	Circumference at base.	
	ft.	ft.	ft.	ins.		ft.	ft.	ft.	ins.
1	19	25	7	3	45	13	20	6	—
3	21	26	7	6	47	16	22	5	9
5	21	28	7	3	49	16	22	6	3
7	20	25	7	—	51	13	20	5	9
9	19	26	7	—	53	15	21	6	—
11	14	19	7	—	55	16	23	6	—
13	16	22	6	9	57	20	26	6	9
15	12	17	5	9	59	16	21	5	9
17	14	20	7	—	61	13	19	6	3
19	18	25	7	3	63	12	19	6	6
21	17	22	6	9	65	19	25	7	—
23	19	24	7	—	67	19	24	7	3
25	12	19	5	—	69	13	21	6	—
27	21	28	7	9	71	17	23	6	3
29	12	17	5	—	73	11	17	6	9
31	17	25	7	3	75	12	17	6	9
33	14	19	5	—	77	11	17	5	6
35	18	22	6	6	79	12	18	7	6
37	19	26	7	—	81	12	18	7	3
39	16	20	5	3	83	12	18	6	6
41	12	15	5	—	85	13	19	7	—
43	19	24	6	6					

TABLE VI.

Control Palms.

Palm No.	Height.	Spread.	Circumference at base.		Palm No.	Height.	Spread.	Circumference at base.	
	ft.	ft.	ft.	ins.		ft.	ft.	ft.	ins.
2	21	30	7	9	46	18	24	7	3
4	20	29	8	—	48	18	25	7	3
6	17	23	6	6	50	14	22	7	3
8	16	22	5	9	52	20	26	7	9
10	20	26	7	6	54	19	25	8	—
12	15	21	6	—	56	20	26	7	9
14	13	19	5	6	58	19	24	7	3
16	16	21	6	3	60	20	26	7	6
18	20	28	8	6	62	14	20	6	—
20	16	23	6	9	64	16	21	6	9
22	15	21	6	6	66	16	22	7	—
24	16	22	7	—	68	11	16	5	6
26	19	24	7	—	70	14	20	6	—
28	19	25	7	6	72	12	18	5	3
30	16	22	6	9	74	12	18	6	—
32	14	20	6	9	76	11	15	5	9
34	15	22	6	9	78	10	14	4	6
36	15	21	6	3	80	11	17	5	9
38	15	21	6	—	82	11	18	6	3
40	13	19	6	—	84	12	17	5	3
42	14	20	6	—	86	13	19	6	6
44	15	21	7	9					

The measurements recorded in Table V and VI show the following comparisons:—

TABLE VII.

Particulars.	Pollinated Palms.	Control Palms.
Average Height of Palms -	15.60 feet	15.67 feet
Average Spread of Palms -	21.49 feet	21.70 feet
Average Circumference at Base of Palm -	6.45 feet	6.63 feet

The measurements summarised above indicate that there is no significant difference in growth between the palms artificially pollinated and those retained as controls.

Summary.

An avenue of eighty-six oil palms has been utilized for a pollination experiment from the time they commenced to

fruit (August, 1924) until the end of December, 1925. The forty-three palms on one side of the avenue were pollinated artificially; those on the other side served as controls.

2. The yield from these two sets of palms are recorded.

3. The records for the year 1925 show a much greater yield of fruit from the pollinated palms than from the control palms.

4. The height, spread, and circumference at the base of each palm are recorded and the averages of the two sets of palms show no material difference.

Reference to Plates.

Plate I. Palm No. 1. Showing the effects of artificial pollination.

Plate II. Palm No. 2. Control Palm. Few fruits are developing.

Plate III. Fig. 1. Male inflorescence. The darkened portion of the scale represents a square inch.
Fig. 2. Female inflorescence. Same scale as Fig. 1.

Received for publication 7th December, 1926.

PLATE I

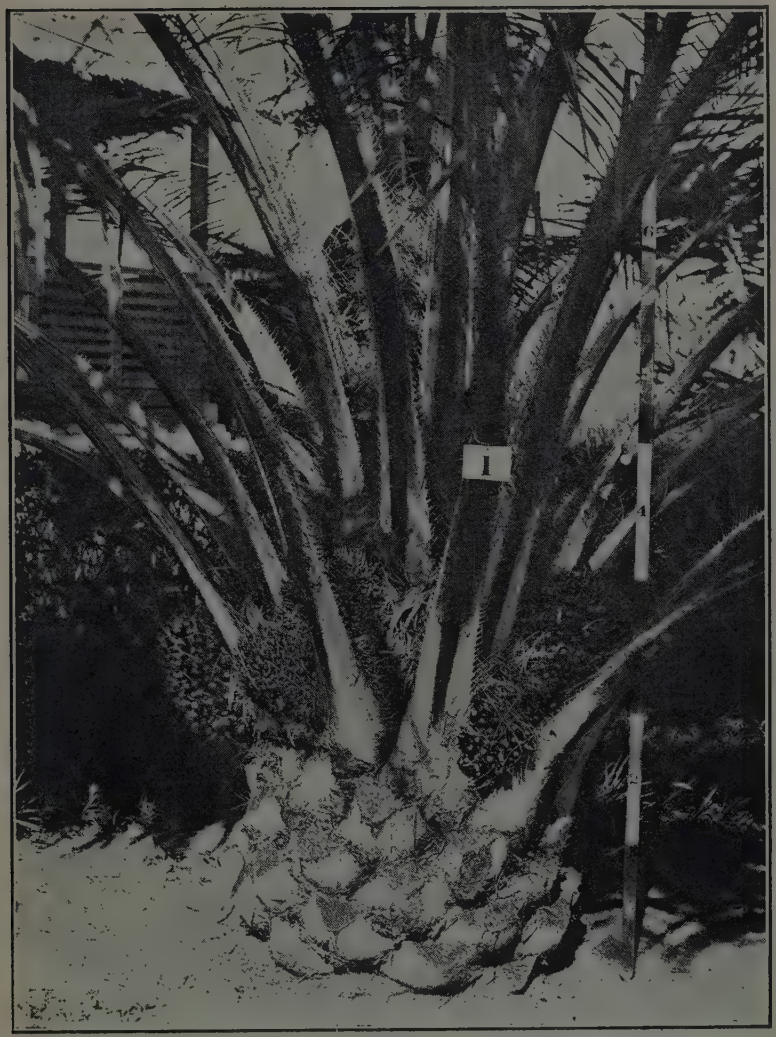

PLATE II

Fig. 1.

FURTHER CROP RECORDS OF YAMS.

J. N. Milsum.

In a previous paper (1). the results obtained at the Government Plantation, Serdang, with the experimental cultivation of a collection of yams were given. The collection included twenty-two races of the greater yam, *Dioscorea alata*, and three races of the lesser yam, *D. esculenta*. Since then a further crop has been raised and these yields are now recorded owing to the number of sets of each race planted being equal, resulting in the yields being more comparable than those obtained previously.

The land planted in the present trials was one chain wide, which allowed of 33 sets, spaced two feet apart, being planted in a row. In calculating the yield per acre of each race, the weight of tubers obtained from each row is multiplied by 165 i.e., the actual number of rows at 4 feet apart which make up an acre. The sets were planted on ridges to which a dressing of well-rotted cattle manure was added at the rate of about 6 tons per acre. The soil below the ridges was not actually trenched but dug to the depth of a 'changkol', i.e., about 8 inches. The time between planting and harvesting was ten months. The plants were all staked with poles about ten feet in length.

The weights recorded in the following tables are those of the tubers after having been thoroughly cleaned of all soil.

TABLE I.

The Greater Yam.

Dioscorea alata.

Race Registration No.	Number of sets planted.	Actual yield, lbs.	Calculated yield per acre, lbs.
10	33	115	18,970
28	33	100	16,500
30	33	105	17,320
44	33	95	13,470
48	33	160	26,400
50	33	84	13,860
64	33	110	18,150
66	33	87	14,350
72	33	120	19,800
76	33	150	24,850

(1) Malayan Agricultural Journal, Vol. XIII, No. 11, p. 356.

TABLE I.—*(Contd.)*

THE GREATER YAM.

Race Registration No.	Number of sets planted.	Actual yield, lbs.	Calculated yield, per acre, lbs.
100	33	90	14,850
408	33	230	37,950
410	33	66	10,890
498	33	150	24,850
510	33	70	11,550
512	33	70	11,550
516	33	67	11,050
518	33	58	9,570
530	33	135	22,270
548	33	40	6,600
622	33	190	31,350
632	33	54	8,910

TABLE II.

THE LESSER YAM.

Dioscorea esculenta.

Race Registration No.	Number of sets planted.	Actual yield, lbs.	Calculated yield per acre, lbs.
270	33	75	12,370
288	33	127	21,950
296	33	105	17,320

THE GREATER YAM.

The average calculated yield per acre of all the races belonging to this species, recorded in Table I, show no marked difference to that obtained in 1925, the figures being 7.4 tons and 7 tons respectively. Certain races show consistent high yields and by planting these, there would appear to be little difficulty in obtaining a crop of 10 tons of roots per acre with average cultural conditions.

In the West Indies, similar yields are recorded (2). A closer planting distance is recommended i.e., ridges 4 feet apart, the sets being spaced 15 inches apart on the ridges. Increased yields are stated to be obtained by trenching the land below the ridges to a depth of 18 inches.

(2) Bulletin of the Department of Agriculture, Trinidad and Tobago, Vol. XXI. Part 1, 'West Indian Yams'.

The averge calculated yields of the three races was 7.7 tons for the 1926 crop and 7.8 tons in 1925. Race No. 288 appears to be a high yielder and the tubers are of excellent quality. A return of 10 tons of roots per acre may be expected from this type of yam.

These yams show promise of being an important food crop in the Malay Peninsula when better known. The tubers are less bulky than those of *D. alata* and do not descend as deep into the soil. They require less cultivation and are more readily lifted. The tubers have good keeping qualities and are easily cooked. No extensive tests have been undertaken at the Experimental Plantation, Serdang, but these yams are found to be very palatable and superior in flavour to the sweet potato. The lesser yam requires to be in the land for a longer period than the sweet potato but a considerably higher yield is obtained, amounting to at least double that usually secured by Chinese growers from their favourite root crop. As to whether Asiatics would undertake the cultivation of this yam as a food crop is a matter of uncertainty.

Mr. P. J. Wester, writing in Bulletin No. 39, Third Revised Edition, Bureau of Agriculture, Philippine Islands, 'The Food Plants of the Philippines' p. 191, remarks regarding this crop. 'In quality the best varieties outrank all other root crops in the Philippines, the yield is very satisfactory, in good varieties ranging from 20 to more than 30 tons of tubers per hectare (1 hectare is 2.471 acres), and in time they will be extensively grown'.

Received for publication 9th December, 1926.

STORING AND PACKING OF BUDDINGWOOD.

The Mededeelingen Van Het Algemeen Proefstation, Der A.V.R.O.S. Rubberserie No. 52 contains an interesting article on "Some Remarks Concerning Storing and Packing of Buddingwood" by Dr. J.G.J.A. Mass and in view of the interest being taken in bud-grafting of rubber trees in the Malay Peninsula it is considered desirable to publish a resume of this work in the Malayan Agricultural Journal.

Experiments on Goenoeng Pamela Estate.—Experiments were made with budding wood from Clone Avros No. 36 on Goenoeng Pamela Estate. The wood was packed and stored in different ways and the final success was ascertained one month after opening the bandages. A distinction was made between old and young material, both kinds being used separately. Part of the young wood was green. Usually the wood was used up to the 3rd or below the 2nd, leaf whorl, calculated from the top of the branch.

It appears that storing in a refrigerator during 14 days at a temperature of 1°—2° C. has a detrimental effect; that completely paraffining the branches is not to be recommended, that paraffining the ends only of the branches offers no advantages in comparison with not paraffining; that if packed immediately and used within one week, young wood yields equally good results as old wood; that when stored for a longer period, young wood deteriorates much more quickly than old wood, but the latter also gives a considerably lower percentage of successful buddings when used after 14 days than within one week; that results with young as well as with old wood were better when used after 3—5 days than after 6—9 days but in the latter case the percentage of success was still quite satisfactory.

Experiments at Medan.—Experiments were made at Medan to obtain indications as to the best method of storing buddingwood after arrival on the estate until it is used.

Buddingwood not used directly on arrival should be stored with the lower end placed in water. Placing the buddingwood with the lower end in water during the time between cutting and packing is also recommended.

Experiments on Aer Temam Estate (Upper Palembang).—Buddingwood was shipped to Aer Temam Estate in upper Palembang Via Singapore, Palembang and Moecara Klingi. Each chest contained young and old wood, treated and packed in different ways. The wood was cut on 25th November, 1925, arrived on Aer Timam on 8th, December and was used on 9th and 10th December—14 and 15 days after cutting. From this experiment it appears that young wood is little adapted for shipment over considerable distances, that it is better to pack buddingwood, wrapped either in jute bags or in banana leaf sheaths, in chests than in crates.

Wrapping in banana leaf sheaths was not advantageous as compared with wrapping in jute bags; banana leaf sheaths will rot during a voyage of 14 days. Dry saw dust is useful as packing material but moist saw dust has a detrimental effect if the saw dust has direct contact with the wood. Moist charcoal is much better adapted as packing material than moist sawdust, when a moist packing material is wanted in order to prevent drying up. Complete paraffining has been found to be inferior to paraffining the ends only of the branches.

If buddingwood is used within 9 days after cutting it appears unnecessary to paraffin the ends of the branches.

The undermentioned is a summary of the experiments made by Dr. J. G. J. A. Mass.

A. If the buddingwood is used within one week after cutting:

1. Young wood is as good as old.
2. Paraffining—at least old wood—is not necessary.
3. Banana leaf sheaths are a quite suitable and easy packing material.
4. It is desirable to use the wood as quickly as possible.
5. The placing of the branches with the lower ends in water, to be refreshed daily, during the time between arrival and use, is to be recommended.

B. If more than one week must elapse between cutting the wood and actual use:

1. Old wood should be used exclusively.
2. The ends of the wood should be paraffined.
3. The small bundles should be wrapped e.g. in jute bags (better than banana leaf sheaths, which rot during transport).
4. The wrapped up wood should be packed in closed chests.
5. The intervening spaces between the bundles of branches should be filled with moist charcoal.
6. On arrival on the estate the paraffin and a small piece of wood should be immediately removed and the branches placed in water till the moment it is used, the water to be refreshed daily.

If the wood is cut in the afternoon, it is probably desirable to place it in water during the night and to pack the next morning.

F. G. S.

LONDON MARKET PRICE LIST, 4th QUARTER 1926.

Oil Seeds.

Castor (Bombay)	-	£15	to £15.2.6	per ton.
Copra (Ceylon)	-	£28.17.6	to £28.10.0	,,
Copra (Straits)	-	£28.13.9	to £27.	,,
Cotton Seed	-	£ 9.15	to £ 9.7.6	,,
Desiccated Coconut (fine)	-	£ 2.0.6		per cwt.
,, ,, (medium)	-	£ 2.0.6		,,
Ground nut (Hull)	-	£20.10.0	to £20.5.0	per ton.
Linseed (Bombay)	-	£17	to £16.7.6	,,
,, (Plate)	-	£15	to £15.5.0	,,
Palm Kernels (West African)	-	£20.2.6		,,

Oils.

Castor (First pressing)	-	£42.10.0		,,
Coconut (Cochin)	-	£53	to £53.10.0	,,
,, (Ceylon)	-	£47		,,
Cotton Seed (Egyptian Crude)	-	£34	to £33	,,
Ground nut (Crude)	-	£40		,,
Linseed	-	£30.15.0		,,
Palm (Lagos)	-	£36.15.0	to £39.5.0	per cwt.
Palm Kernel	-	£40		per ton

Oil Cakes.

Coconut	-	£ 8.12.0	to £9.7.6	,,
Cotton (Egyptian seed)	-	£ 6. 5.0	to £7	,,
,, (Bombay seed)	-	£ 5. 7.6	to £6	,,
Ground nut (London decorticated)		£12	to £10.10.0	,,
Linseed 9%	-	£11.10.0	to £12. 5.0	,,
Palm Kernel	-	£ 6.17.6	to £7.5.0	,,

Essential Oils.

Cajeput	-	2/6		per lb.
Camphor (Chinese Crude)	-	2/6		,,
,, (Japanese, Refined)	-	2/10d	to 3/3	,,
Camphor oil (White, distilled)	-	£ 3.2.6		per cwt.
Cinnamon (Ceylon leaf)	-	6/6	to 6/9	per lb.
Citronella (Ceylon)	-	1/6½	to 1/5½	,,
,, (Java)	-	2/4	to 2/2	,,
Clove (90 to 92%)	-	6/-	to 5/10	,,
Lemon grass (Cochin)	-	3/7	to 3/6	,,
Lime (West Indian, distilled)	-	£ 1.16.0		,,
Patchouli (Penang)	-	30/-	to 31/-	,,
Vetiver (Bourbon)	-	35/-	to 40/-	,,

Spices.

Capsicums (East Indian)	-	£2/	to £2.5.0	per cwt.
,, (Nassaland)	-	£3/	to £3.10.0	,,
Chillies (Zanzibar)	-	£1.15.0	to £2. 2.6	,,
,, (Nyassaland)	-	£2.10.0	to £3	,,
,, (Japan)	-	£4.15.0		,,
Cinnamon (Ceylon)	-	2/		per lb.
Cloves (Zanzibar)	-	9d	to 10d	,,
,, (Penang)	-	2/-	to 2/2	,,
Ginger (Japan)	-	57/6		per cwt.
,, (Jamaica)	-	60/-	to 85/-	,,
Mace (Bombay and Penang)		3/10	to 4/-	per lb.
Nutmegs (Singapore and Penang)				
110's	-	1/10		,,
80's	-	2/2		,,
64-57's	-	2/5	to 2/6	,,
Pepper (Singapore black)	-	9½d		,,
,, (Singapore white)	-	1/3½	to 1/4	,,

Drugs.

Chaulmoogra (genuine)	-	3/		,,
Ipecacuanha (Rio)	-	14/3	to 14/6	,,

Natural Dyes & Extracts.

Annatto	-	3d	to 4d	,,
Gambier (block)	-	40/-		per cwt.
,, (cube)	-	65/-		,,

Gums & Resins.

Damar (Singapore)	-	30/-	to 155/	,,
,, (Batavia)	-	125/-	to 155/-	,,
Dragon's Blood (reed) Nom.	-	£15-	to £20	,,
Gutta percha (genuine)	-	2/9	to 6/-	per lb.
,, (Sarawak)	-	3/-	to 4/-	,,
" (Siak reboiled)	-	1/ 5		,,

Fibres.

Cotton (American Go. to Mid)	-	8.20d	to 4.54d	,,
,, (Egyptian Sakellarides G. F. to Fine)	-	19.25d	to 13.40d	,,
Hemp (Manilla " J" Grade)	-	£44	to £45	per cwt.
,, (Mauritius)	-	£42	to £33	,,
,, (New Zealand)	-	£34	to £38	,,
,, (Sisal)	-	£22	to £43.10.0	,,
Kapok (Indian)	-	1/-	to 1/0½	per lb.
,, (Java)	-	1/4½	to 1/4¾	,,

Foodstuffs.

Arrowroot (Natal)	-	8d	to 9d	per lb.
Cocoa (Ceylon Plantation)	-	70/-	to 84/-	per cwt.
Coffee (Malay Plantation)	-	110/-	to 130/-	,,
,, (Liberian)	-	100/-	to 105/-	,,
Sago (Pearl)	-	28/-		,,
,, (Flour)	-	17/6	to 18/6	,,
Tapioca (Singapore, flake)	-	2½d	to 3d	per lb.
,, (flour)	-	18/-	to 22/-	per cwt.
,, (Seed pearl)	-	17/-	to 22/-	,,

Chemicals.

Acetic Acid (glacial)	-	£65	to £66	per ton.
,, (80% con)	-	£37	to £38	,,
Acetone	-	£70	to £64	,,
Ammonia (·880)	-	£21.12.6	to £22	,,
Calcium Acetate (grey)	-	£17.10.0		,,
Citric Acid	-	1/3	to 1/3¼	per lb.
Formic Acid (85%)	-	£48.10.0	to £46.7.6	per ton.
Formalin (40% vol)	-	£40	to £40.7.6	,,
Lime Juice (Conc) nom	-	£17.0.0		,,
Sodium bisulphite (60 to 62%)	-	£17		,,
Sodium Sulphite (anhydrous)	-	£14		,,
Sulphate of Ammonia	-	£11.9.0	to £11.16.0	,,
Wood Creosote (Unrefined)	-	2/9		,,

Trade has been restricted, especially in oils and its by-products, which is reflected on a further downward tendency in prices. Linseeds however, have remained firm. Spices remain at about last quarters level. Annatto is quite featureless, while gambier remains at the same price.

Fibres shew great activity; Cotton has made a sharp decline. Manila and New Zealand Hemp remain firm, while Mauritius is quoted lower.

The Chemical market shews some improvement owing to the more settled industrial situation in the United Kingdom.

Note. The above market price list covers the first two months of the fourth quarter. It is intended to indicate the trend of prices over the period under review. The list is based on various issues of the following journals published during October and November 1926.

Lewis and Peat Monthly Prices Current: Lewis and Peat, West Indian, Central American and Brazilian Monthly Market Report; Tropical Life; British Trade Journal; Fertilisers and Feeding Stuffs Journal; Chemist and Druggist; Chemical Trade Journal; Chemical Age; Perfumery and Essential Oil Records.

DRAWN & PRINTED BY F. M. S. SURVEYS NO. 48 - 1926.